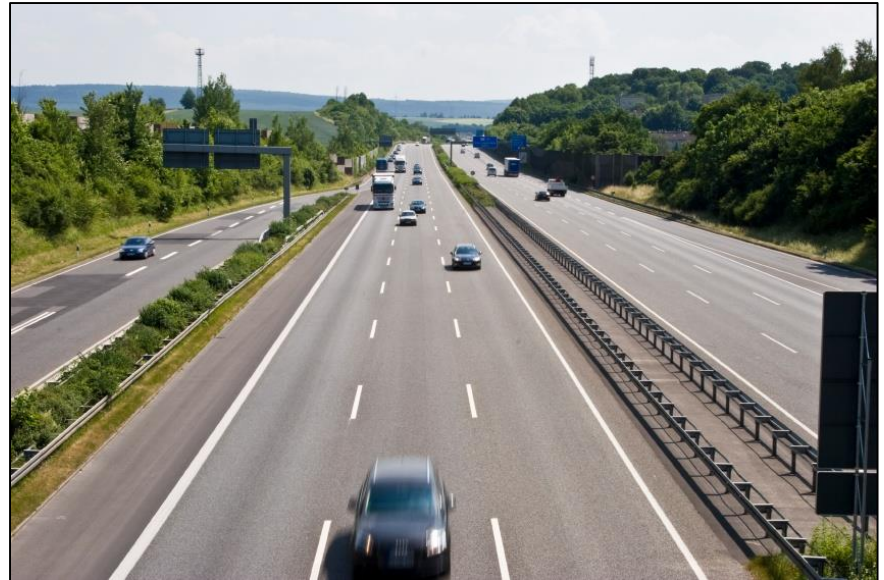# PM Hot-spot Modeling: Lessons Learned in the Field

Chris Owen

U.S. EPA

EPA RSL Modelers' Workshop

Wednesday, May 21st, 2014

Overview

- Background
- State and local lessons learned so far
- EPA resources
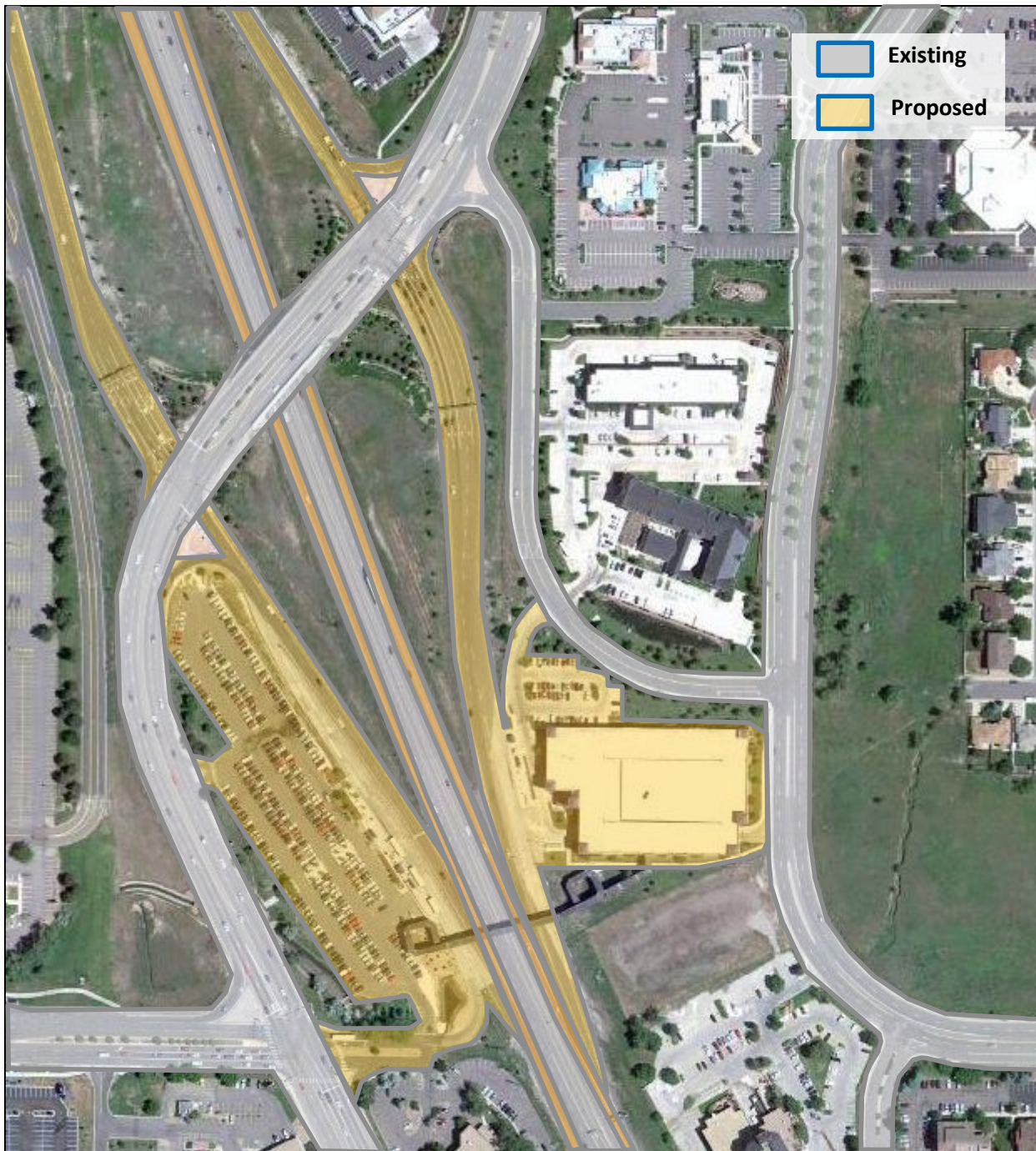
Conformity Requirements

- CAA and transportation conformity rule (40 CFR Part 93) require that federally supported transportation projects in nonattainment and maintenance areas cannot:
  - » Cause or contribute to new air quality violations,
  - » Worsen existing violations, or
  - » Delay timely attainment of the NAAQS or interim milestones

- A **hot-spot analysis** is an estimation of likely future localized pollutant concentrations and a comparison to the CO, $PM_{2.5}$, and PM_{10} NAAQS
  - » In PM areas, required for major new or expanded highways, intersections, or terminals that significantly increase diesel traffic

- A project meets conformity, if at each appropriate receptor:
  PM concentration of build $\leq$ NAAQS, *or*
  PM concentration of build $\leq$ PM concentration of no-build

EPA Guidance

- In December 2010, EPA released original PM Hot-spot Guidance
  - » Developed through Agency-wide effort and stakeholder involvement
  - » EPA's November 2013 guidance update supersedes the 2010 guidance
- Provides first-of-its-kind method for estimating air quality impacts of specific transportation projects
  - » Emissions from EPA's MOVES model → input to AQ model (AERMOD)
  - » Estimate a project's impact on air quality concentrations
  - » Relevant for other modeling applications

Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas

Example of Project Needing a PM Hot-spot Analysis

Characterizing Emission Sources

	Line Source	Point Source	Area Source	Volume Source
Different source types can be used in a hot-spot analysis to represent…	• Highways and intersections	• Bus garage or transit terminal exhaust stacks	• Transit or freight terminals • Parking lots • Highways and intersections	
Model	AERMOD* CAL3QHCR	AERMOD	AERMOD	

*AERMOD can simulate line sources using a series of adjacent area or volume sources.

Note: Only approved versions of models on SCRAM can be used for PM hot-spot analyses

Guidance Reference:

Sect 7.3.2, 7.4, App J.3.3-3.5

# Air Quality Modeling Issues in Field

- Characterizing area and volume sources

- Specifying receptors in project area

- Running the air quality model

- Note: Interagency consultation has been important for determining appropriate air quality model, methods, and data

Area Source Characterization

$(X_1 Y_1),(X_2,Y_2)$ = Coordinates of area source end-points
W= Roadway width
Szinit = Initial depth of plume

MOVES emission rate (e.g. 5.6E-05 g/s/m^2)

(X_2, Y_2)

(X_1, Y_1)

Width

Receptor B

Receptor A
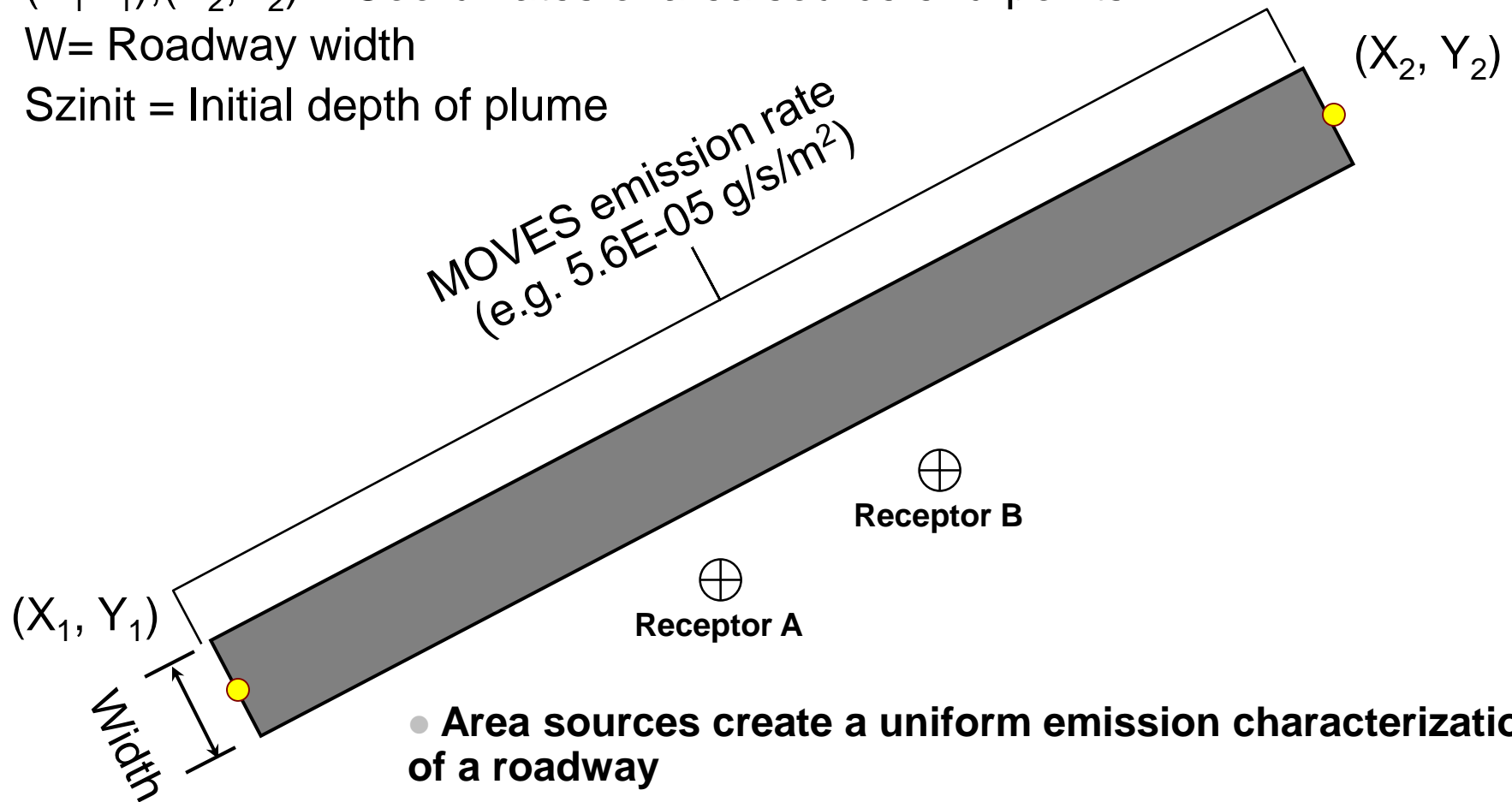
- **Area sources create a uniform emission characterization of a roadway**
- **Note: A warning will be generated in AERMOD if the aspect ratio is greater than 100 – this can be ignored**

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Area Source Characterization

- Most projects will include many roadway links
- Area sources may be easier to use:
  - » $(X_1Y_1),(X_2,Y_2)$ defined for each source
- GIS software is essential for this process
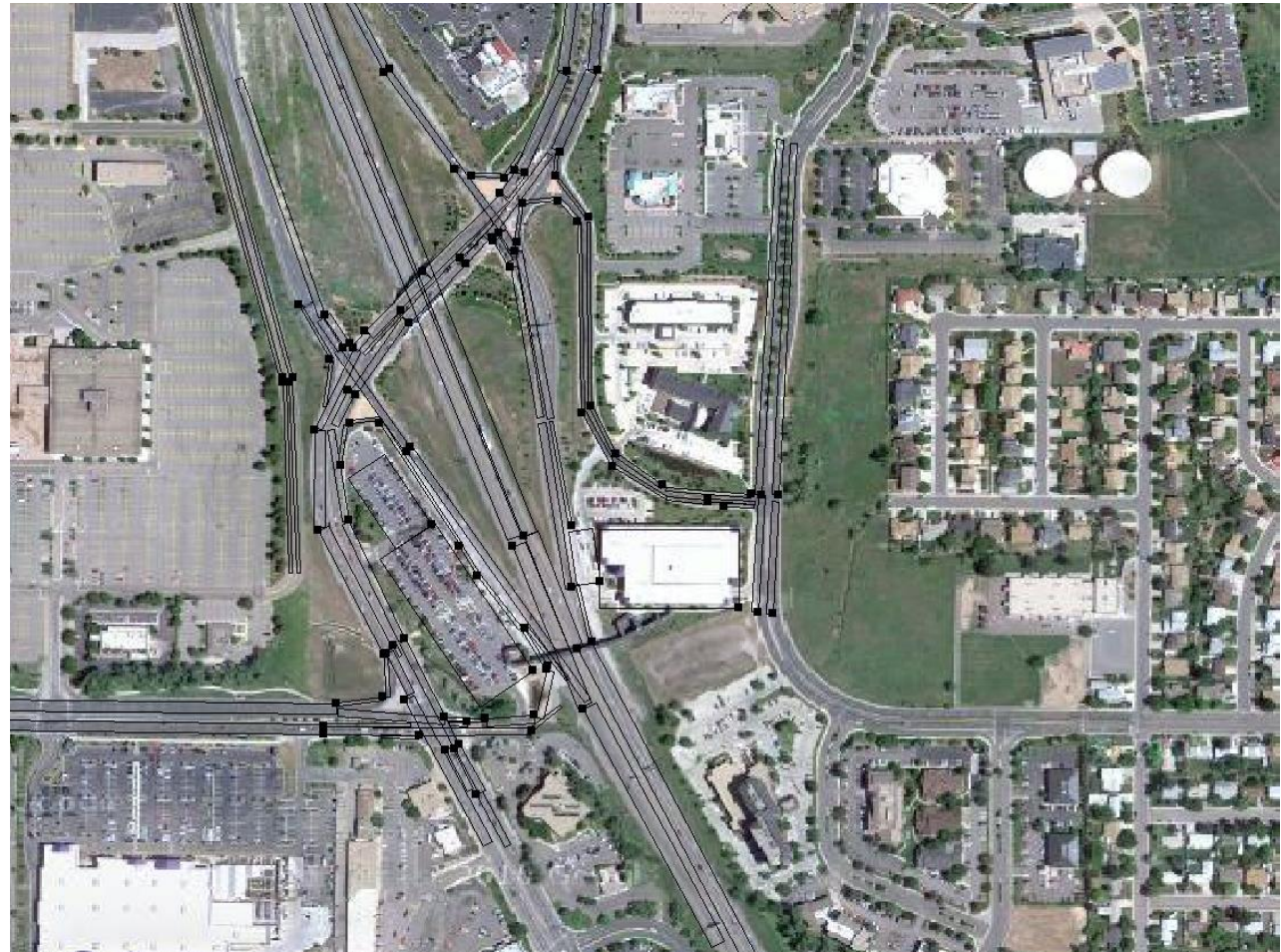
A Highway Link as a Series of **Volume** Sources

- Xs, Ys = Coordinates of volume source center
- Syinit = Initial lateral dispersion coefficient (W / 2.15)
- Szinit not shown

Syinit

Source Width (W)

Exclusion zone

Exclusion zone (radius = Syinit * 2.15 + 0.99 m)
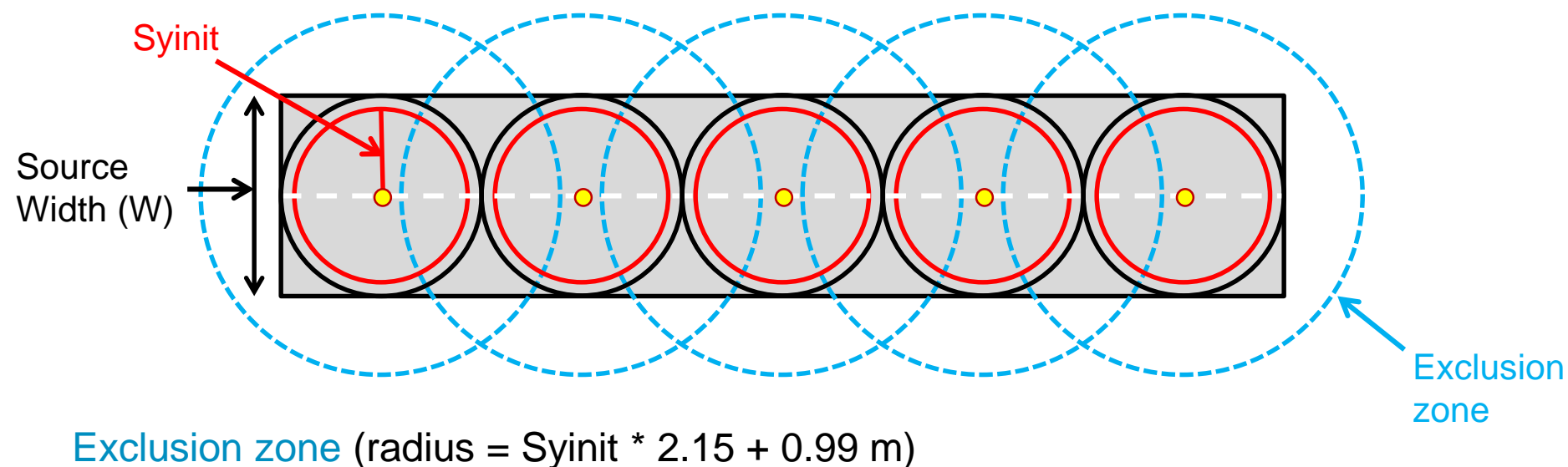
Volume Sources

Issues to consider when using volume sources:

1. Source width

2. Spacing

Volume Sources: Appropriate Width

- Receptors <u>should not</u> be placed within exclusion zone
  - » based on EPA guidance from OAQPS
  - » concentrations are not calculated within it

- Receptors <u>should</u> be sited as near as 5 m from a source (e.g., the edge of a traffic lane)

- Because of the exclusion zone, the width of a volume source should be **≤ 8 m**
  - » Typical highway lane = 12 ft (3.6 m)

- Model any 3 lane or larger highway using
 - » Volume sources for each lane, or
  - » Area sources

Guidance Reference:

Section 7.6.2

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Incorrect Volume Source Width

- Volume sources are too wide, excluding area where receptors should be placed
- W = Link width

W

Receptor A ⊕

Receptor B ⊕
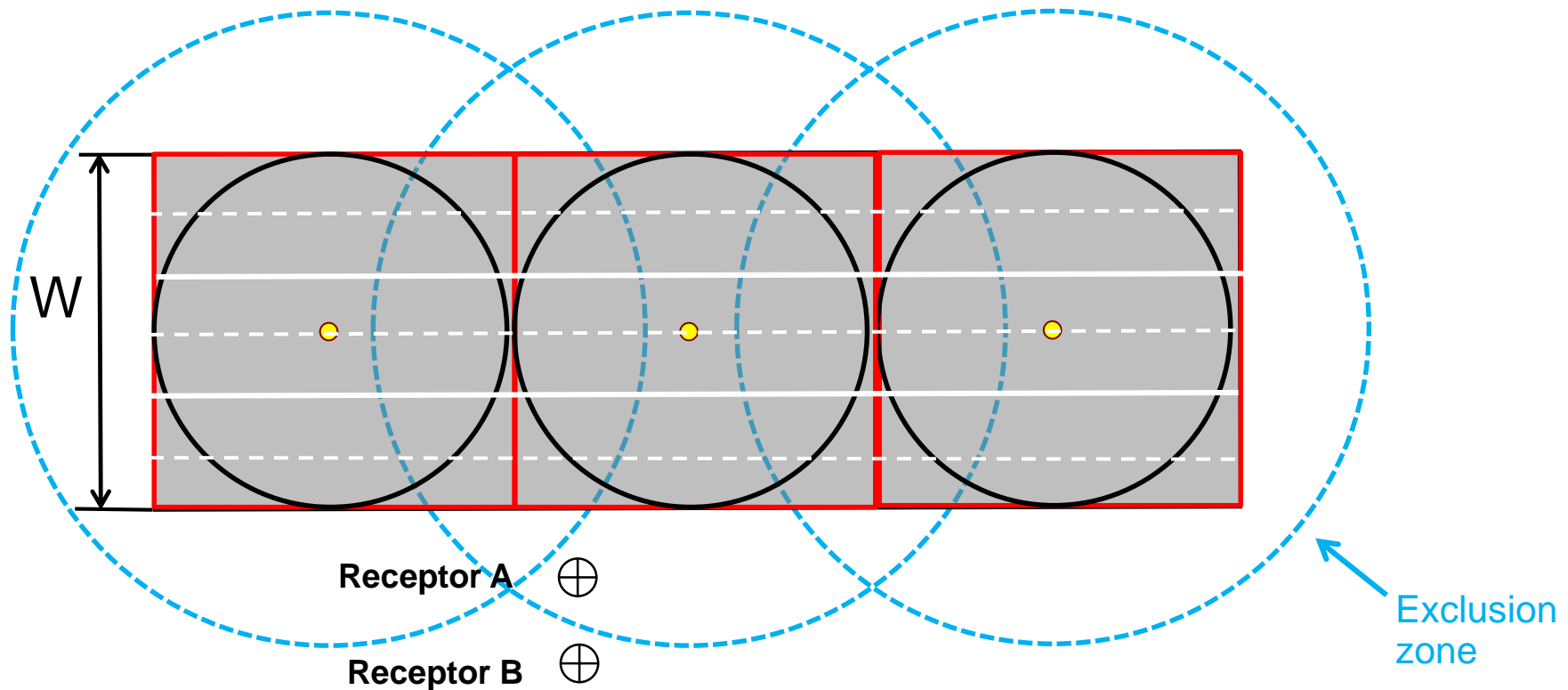
Exclusion zone

Correct Volume Source Width

- Volume sources are no more than 8 m wide
  - » Receptor A is no longer in the exclusion zone

W

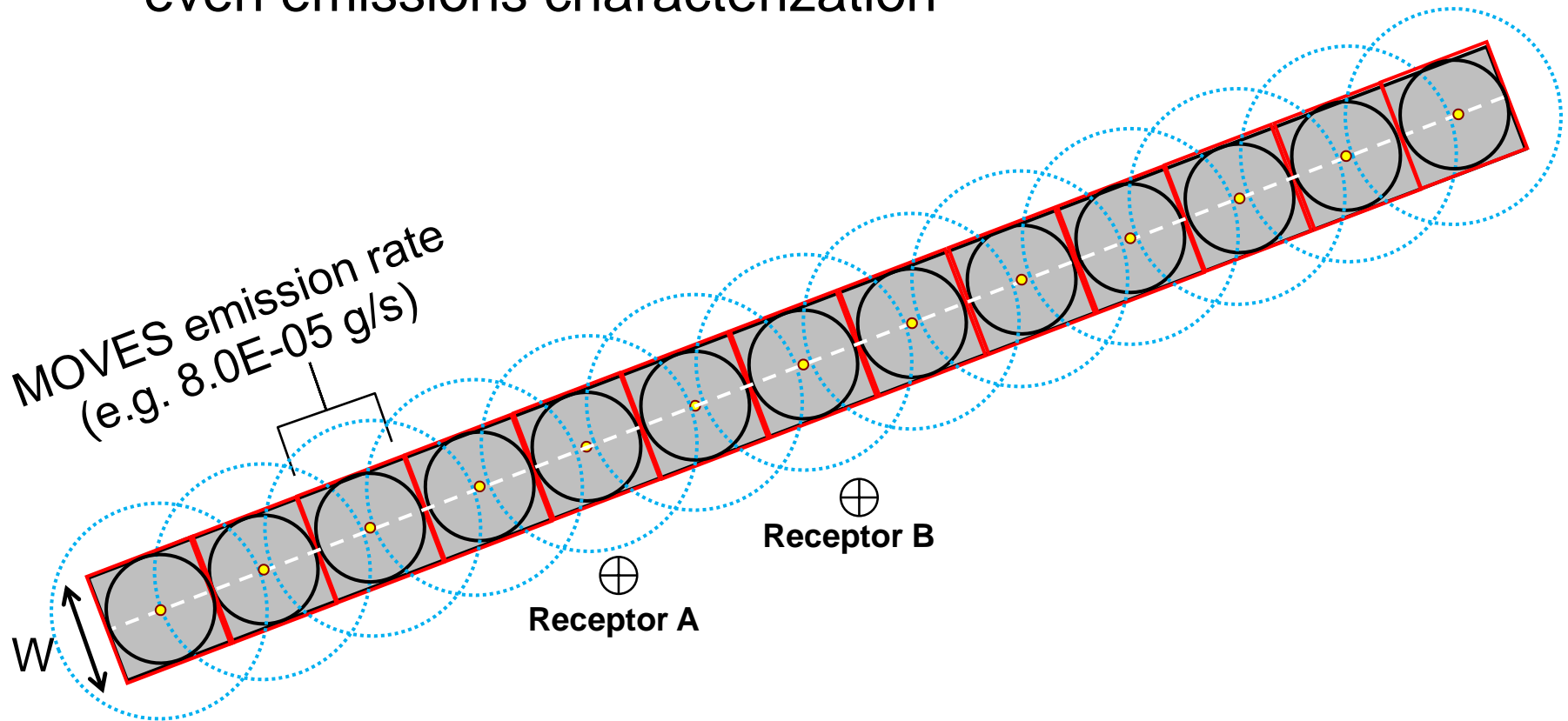Receptor A ⊕

Receptor B ⊕

Exclusion zone
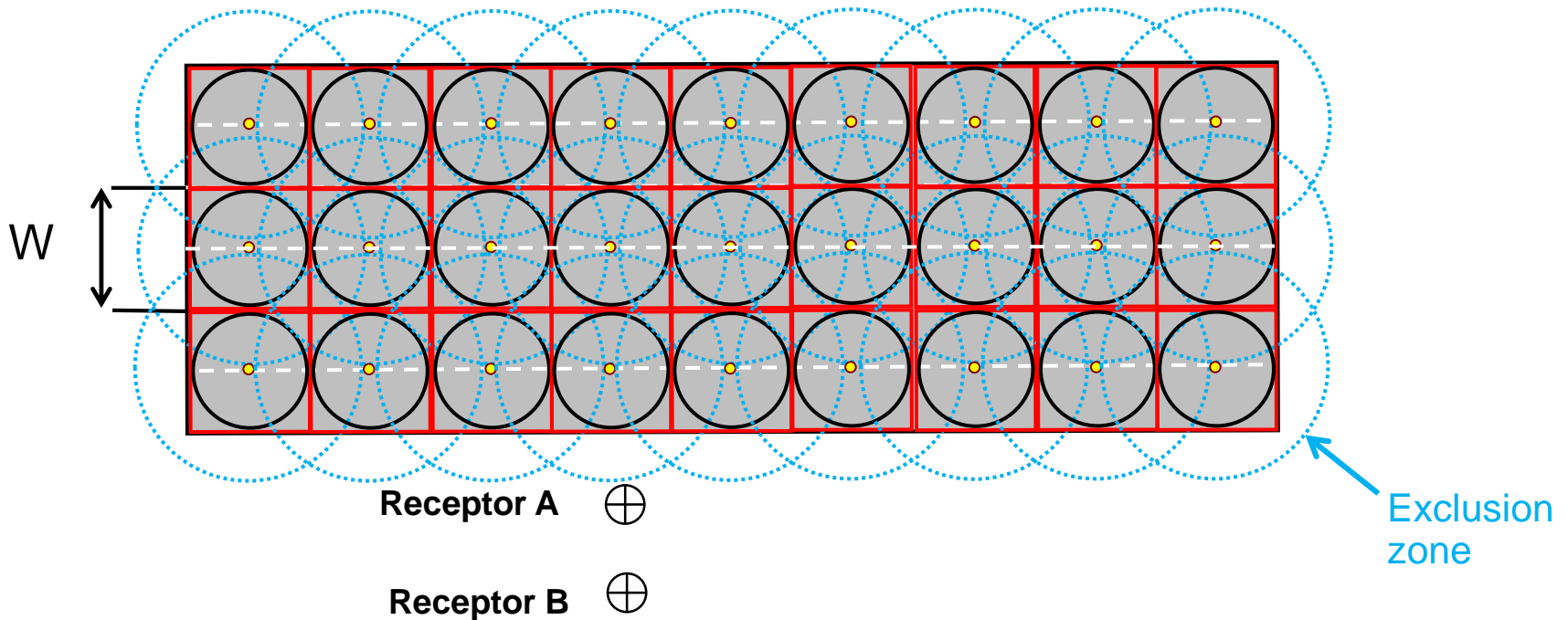
Incorrect Volume Source Spacing

- Volume sources are spaced too far apart, which creates a non-uniform emission characterization
- Adjacent receptors, depending on their proximity to the center of a volume source, are over/underestimated

MOVES emission rate
(e.g. 3.2E-04 g/s)

W

Receptor A

Receptor B
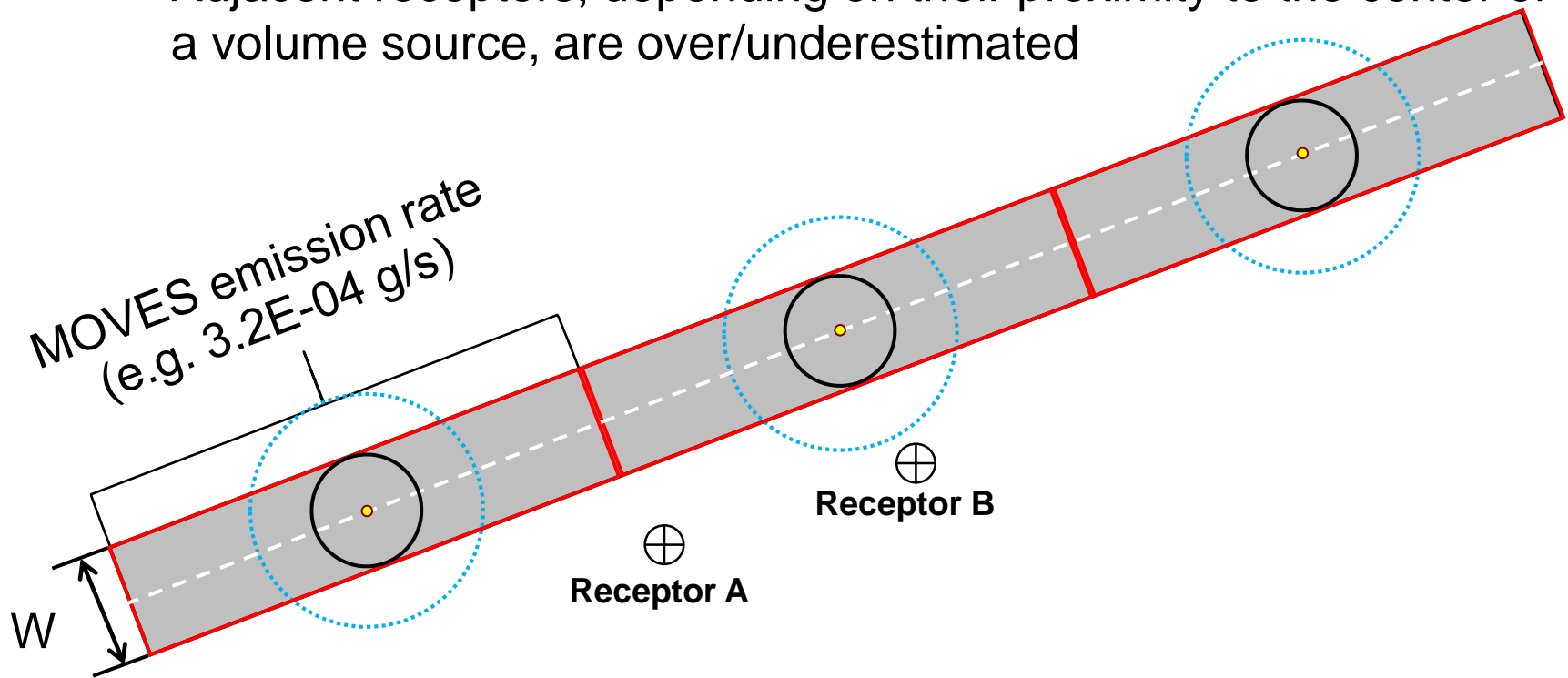
Correct Volume Source Spacing

- Adjacent volume sources, spaced properly, create an even emissions characterization

MOVES emission rate (e.g. 8.0E-05 g/s)

Receptor A

Receptor B

W

Running the Model

- Hot-spot analyses may cover large geographic areas (e.g., a 15 mile long highway expansion) and include hundreds of sources and potentially thousands of receptors

- EPA recommends the following strategy to minimize AERMOD run-times:
  - » Modeling the areas of highest likely impact:
    - – May be evident from traffic volumes, emission rates
    - – Can be determined from an iterative modeling process (using FASTALL and/or coarse receptor grid)

- Some users have expressed interest in parallel processing
  - » Use of commercial software is covered in a Dec 2007 EPA clarification memo
  - » Decisions on the use of third-party software is the EPA Region's responsibility

MOVES2AERMOD

- EPA created an interface between the MOVES emission model and the AERMOD dispersion model

- Designed specifically for use in PM Hot-spot Analyses – Available only for **Area** sources at this time
  - » Uses output from 16 MOVES runs (representative time periods)
  - » Produces SEASONHR EMISFACT table that can be used directly in an AERMOD input file

- Script can be run through the MOVES GUI

- Download package available on the MOVES Tools website: http://www.epa.gov/otaq/models/moves/tools.htm

For More Information

- See EPA's conformity project-level website for:
  - » Regulations, policy guidance, FR notices, training
  - » www.epa.gov/otaq/stateresources/transconf/projectlevel-hotspot.htm

- See EPA's MOVES website for:
  - » Software, MOVES MySQL scripts, technical documentation, and other helpful background materials
  - » www.epa.gov/otaq/models/moves/

- Questions?
  - » Specific questions on a particular project analysis
    - – Contact appropriate EPA Region or DOT field office
  - » General questions on PM hot-spot guidance and training
    - – patulski.meg@epa.gov
  - » Technical questions about guidance document
    - – conformity-hotspot@epa.gov